FRD Activities Report
October 2001

Research Programs

URBAN/VTMX 2000 & 2003

The focus on URBAN/VTMX 2000 and URBAN 2003 has returned. A final report is in preparation for the 2000 field study. The current effort for this month centered on the mobile SF_6 analyzer data. More than 825 traverses of SF_6 plumes were made by the 6 mobile analyzers during the 6 regular and 1 shake-down intensive observation periods (IOP). An additional 130 null traverses were made by the analyzers to verify the lack of SF_6. These data have been plotted and prepared for inclusion in a data appendix.

URBAN 2003 is also moving ahead. Coordination has begun between FRD and the two funding agencies, the Chemical and Biological Non-proliferation Program (CBNP) of the U.S. Department of Energy, and the Defense Threat Reduction Agency (DTRA). Future visits to Oklahoma City, Oklahoma, to begin logistical and public relations work is in the planning stages. (Kirk.Clawson@noaa.gov)

CBLAST-Low

Final post-processing of the CBLAST-Low LongEZ aircraft data set was completed. The post processing algorithms were used to create the final data set which are now being disseminated to project PI's. Key elements of the processing routines include replacing the raw GPS data with differentially corrected velocities and positions, blending low frequency velocities and attitudes (from GPS) with higher frequency components from accelerometers, correcting temperature measurements for dynamic heating of the element, calculating winds based on the raw pressure measurements, and careful quality control checks. With the upgrades to the LongEZ data system hardware and software, this data set does not contain many of the timing errors and missing data points that plagued the system in previous experiments. Likewise, much of the post processing effort is being spent on careful calibrations to remove residuals in the wind calculations resulting from dynamic aircraft maneuvers. While this has little effect on the resultant mean wind, it is critical in determining the flux in gusty conditions. (Jeff.French@noaa.gov, Jerry Crescenti, Timothy Crawford)

VTMX/URBAN 2000

An effort is underway to combine the ground-based tower and remote sensor (radar wind profiler and Doppler sodar) observations acquired at the Raging Waters in October 2000 with the LongEZ aircraft data during VTMX/URBAN 2000. In particular, the wind regime is being examined for Intensive Observation Period (IOP) 10 (starting 1500 MST on 25 October 2001 and ending at 1200 MST on 26 October 2001). The 10-m tower and sodar data show an oscillation

between southerly winds of 4 to 5 m s^{-1} and southeasterly winds of 2-3 m s^{-1} in the early morning hours of 26 October (Figure 1). These southeasterly and southerly winds appears to be a drainage flow and are about 200 to 250 m. Further investigations on the nature of these winds will continue. (Jerry.Crescenti@noaa.gov)

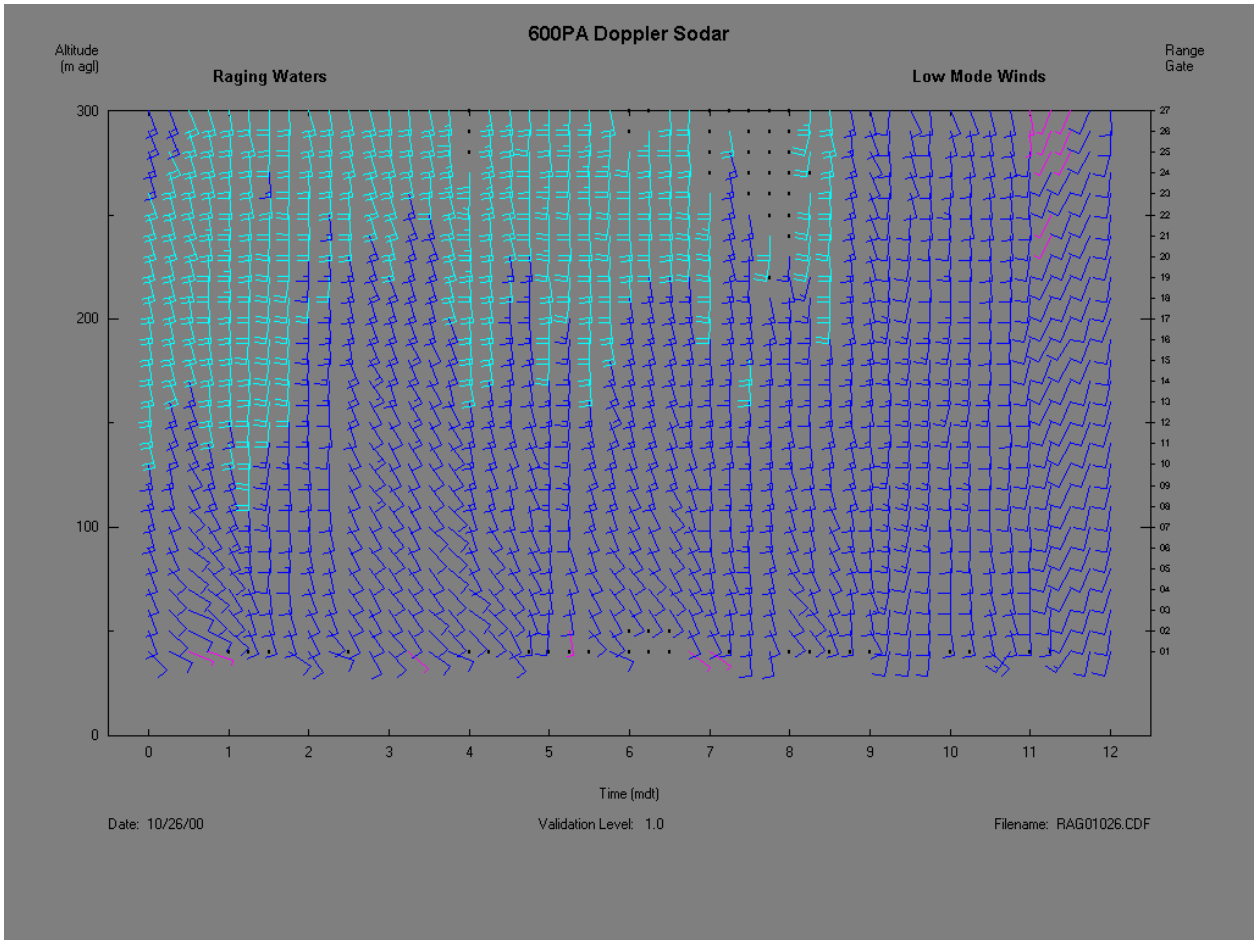

Figure 1. Wind vectors acquired by the Raging Waters Doppler sodar from 0000 to 1200 MST on 26 October 2001 during VTMX/URBAN 2000 IOP 10.

CASES-99

A collaboration is underway with Carmen Nappo at ATDD in Oak Ridge to write a follow-up proposal for CASES-99. The original proposal mainly covered the field deployment and data processing for the CASES-99 experiment. The new proposal considers using the CASES-99 data to investigate the frequency and importance of gravity waves in the nocturnal boundary layer. Data from several platforms, including towers, the Long-EZ aircraft, and remote sensors would be used in this effort. The proposal would be submitted to the Army Research Office. (Richard.Eckman@noaa.gov)

Wind Calculations from a Small Aircraft

Central to the use of the LongEZ as a platform to investigate Boundary-Layer phenomena is the ability to determine, very accurately, the three-dimensional wind vector. Considerable effort at ATDD and, more recently, FRD over the last 15 years has focused on reducing errors in the determination of aircraft velocity which may lead to rather large errors (percentage- wise) in wind calculations. Recent projects, such as CBLAST-Low that focus on boundary layers under extreme light wind conditions have forced us to re-visit some of the earlier work in determining precisely the relationship between our measurements and the winds calculated from those measurements. The process relies on performing various maneuvers (such as pitch up/downs and 360 degree steady-state turns) and from wind calculations during those maneuvers, adjusting sensitivity and offset calibration factors to force the wind to match certain basic assumptions (*i.e.* minimize variance of wind during a turn). Previously, we have been able to reduce the variance in computed vertical air velocity to within 5 % of the vertical velocity of the aircraft, much better than the typical value of 10% cited by many investigators as being the level to achieve. Further refinement, and careful calibration of the instruments has allowed us to achieve a 3% level with the current CBLAST-Low data set. By reducing variance of the horizontal winds during turns through the adjustment of airspeed sensitivity measurements and heading misalignment, we have been able to remove nearly all of the variation in wind speed and direction during turns. But, as Figure 2 demonstrates, turns in different directions typically lead to different solutions. Note, however, that our method of calculating the wind allows us to achieve what most other aircraft groups are not able to achieve, specifically usable winds during turns.

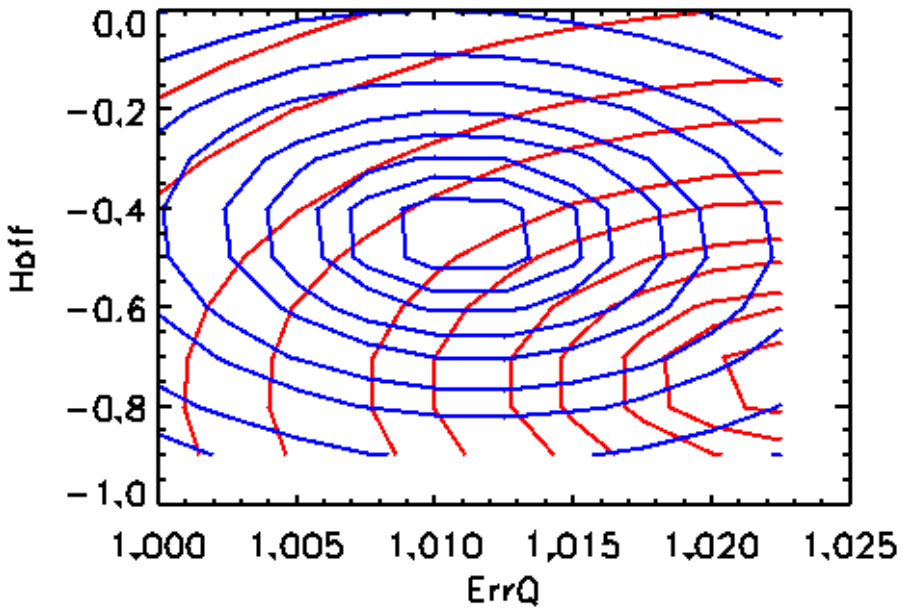

Figure 2. Contours of Variance of wind speed as a functions of heading offset (Hoff) and airspeed sensitivity (ErrQ). The two sets of contours are for a wind circle to the right (blue) and a wind circle to the left (red).

In addition, we find that under our current method of wind calculation, there exists a bias in vertical air velocity that is fairly well correlated with airspeed (Figure 3). Both of these findings suggest that our model of airspeed sensitivity errors likely needs to be refined, and that with such refinements, we may be able to further reduce errors in our wind calculations. (Jeff.French@noaa.gov)

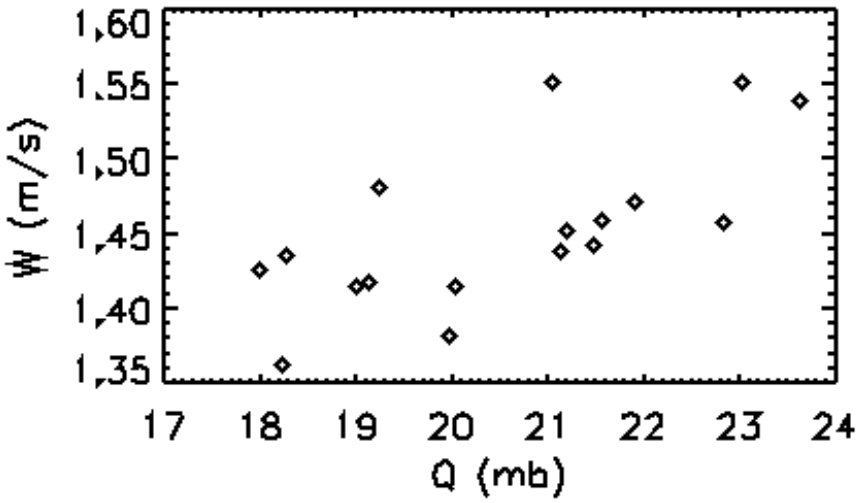

Figure 3. Plot of mean vertical air velocity over several kilometers as a function of mean airspeed. Even when the offset of roughly 1.45 ms^{-1} is removed we find that remains a fairly strong correlation (~0.7) between airspeed and mean vertical velocity.

Tracer Technology

The prototype for the updated Automated Tracer Gas Analysis System (ATGAS) underwent significant design changes based on comments from the instrument operators. The controls were rearranged to be more convenient and the components were reorganized to simplify maintenance of the system. Software support for the new instrument is now operational and the system has been undergoing testing this month. It is consistent in its operation and easy to work with. Once testing is complete, a total of four systems will be built for use in future atmospheric tracer experiments. (Roger.Carter@noaa.gov, Debbie Lacroix, Shane Beard)

Cooperative Research with INEEL

Emergency Operation Center (EOC)

The INEEL Emergency Operations Center is completing its annual requalification cycle. Most of the FRD employees who support the EOC as meteorologists have participated. The training has centered on the EOC's new Information Management Program whereby all emergency personnel

in the EOC and at the satellite Emergency Control Centers have access to all information simultaneously. (Kirk.Clawson@noaa.gov and staff)

INEEL Annual Dispersion Modeling

In October, FRD completed a series of dispersion modeling runs that will be used in the INEEL Site Environmental Report for calendar year 2000. These runs were performed with the MDIFFH puff model, which is similar to the MDIFF model routinely used by FRD except that it uses hourly meteorological data rather than 5-minute data. The hourly meteorological data were provided by another program that reads in the raw data from the INEEL Mesonet and computes hourly averages.

MDIFFH was run using all the available Mesonet data from calendar year 2000. Several changes were made in the model runs compared to previous years. In prior years, it was assumed that all the INEEL pollutant was released at a single location at the southern end of the site. For 2000, the pollutant was spread over six release locations. The model runs were also modified so that the total integrated concentration was directly computed at over 60 residential locations around INEEL. This will simplify the estimation of the dose received by the maximum exposed individual. Figure 4 shows concentration isopleths based on the 2000 data. (Richard.Eckman@noaa.gov)

INEEL Mesoscale Modeling

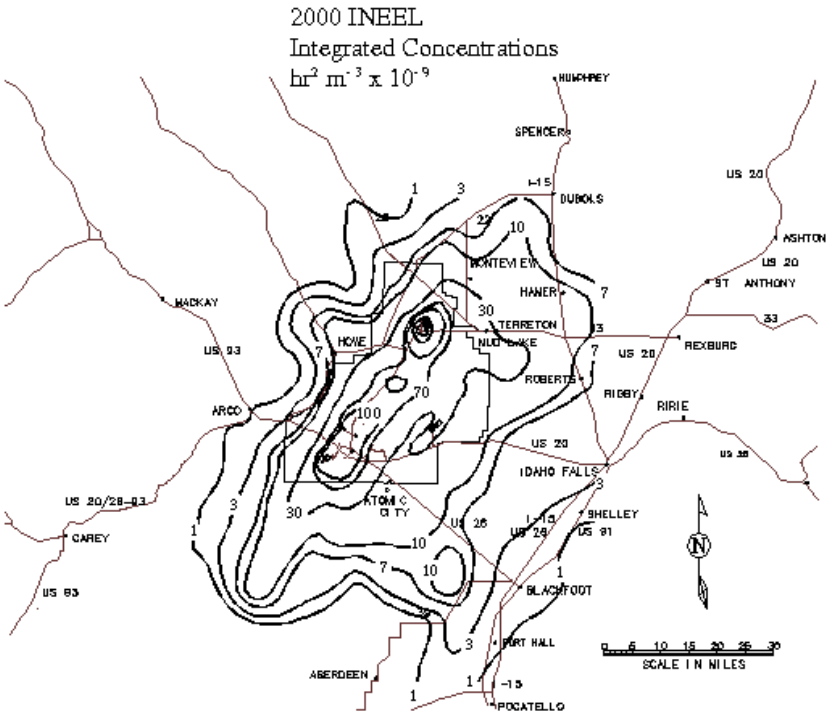

Figure 4. INEEL total integrated concentrations for calendar year 2000. The concentrations have been normalized by the source strength.

The Alpha workstation used for MM5 modeling at FRD was brought back online in October, and is again producing high-resolution forecasts for INEEL. The execution time of the model was significantly reduced by taking better advantage of the parallel-processing directives that have been put into the newer versions of MM5. These directives are based on a standard called OpenMP, which is platform independent. The Fortran compiler available on the FRD Alpha workstation understands the OpenMP directives, so the machine can better utilize its two processors. With the three grids currently in use, the MM5 runs require about 7-8 minutes to complete an hour of simulated time.

The MM5 runs are also being used to provide forecast trajectories from INEEL. Figure 5 shows an example for two trajectories starting from INEEL at 1200 MST. One starts from the northern

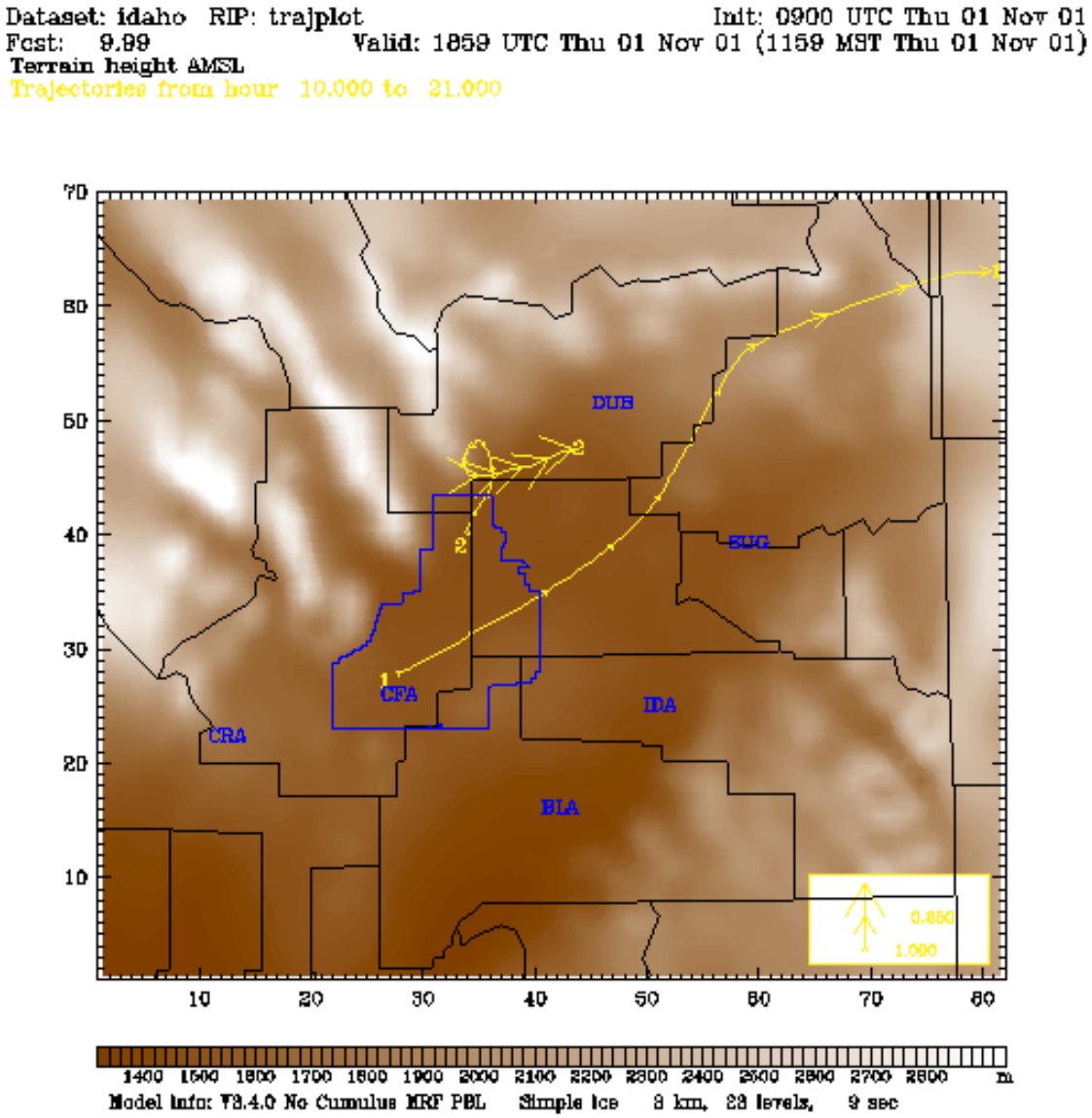

Figure 5. Trajectories computed from MM5 simulation for two points in INEEL. Both trajectories start at about 35 m AGL. The arrowheads increase in size as the trajectories ascend.

end of the site (outlined in blue) and the other from the southern end of the site. Both of them start at about 35 m AGL. The southern trajectory runs up the Snake River Plain and exits the domain near Yellowstone National Park. The northern trajectory gets caught in mountain currents along the western side of the plain, and shows significant vertical ascent. (The arrows get larger as the trajectory rises.) Trajectories of this type will be a useful tool in forecasting pollutant transport from INEEL. (Richard.Eckman@noaa.gov)

Community Monitoring Stations

Datalogger software has been completed that operates the large community monitoring display that allow the public to view current meteorological conditions as they walk or drive by the two schools. The sign displays wind direction, wind speed, temperature, wind chill temperature, precipitation and background radiation. The display allows three seconds of display time each meteorological parameter before displaying the next. (Randy.Johnson@noaa.gov, Roger Carter, Tom Strong, Kirk Clawson)

Other Activities

NRC Postdoctoral Fellow

A National Research Council (NRC) postdoctoral invitation has been extended to Tamara K. Grimmett from the University of California at San Diego to work at FRD. Tami is an mechanical engineer who will work with Jerry Crescenti on air-sea interaction research using the LongEZ data from WAPEX, SHOWEX, and CBLAST-Low. Tammy finished Ph.D. work earlier this month and reported to FRD on October 29. (Jerry.Crescenti@noaa.gov)

Figure 6. NRC post-doc Tami Grimmett.

Presentations

Jeff French presented a seminar entitled *Wind Calculations from a small Aircraft: Trick or Treat?* on October 31. The seminar outlined the difficulties with computing accurate wind vectors from a moving platform. It was attended by staff from FRD and ATDD (via phone link and internet).

Proposal

Randy Johnson has submitted a proposal to install a meteorological station and an air quality monitoring equipment for the Wind River Environmental Quality Commission in central Wyoming. This system would be installed, operated and maintained by FRD for one year.

Papers

Crescenti, G. H., J. R. French, and T. L. Crawford, 2001: Aircraft measurements in the Coupled Boundary-Layer Air-Sea Transfer (CBLAST) light wind pilot field study. NOAA Technical Memorandum OAR ARL, Silver Spring, MD, in preparation.

Papers Reviewed

Randerson, D. and J. B. Sanders, 2001: Characterization of cloud-to-ground lightning flashes on the Nevada Test Site. *NOAA Tech. Memo.*, reviewed by Jeff French.

Min, I. A., R. N. Abernathy, and H. L. Lundblad, 2001: Measurement and analysis of puff dispersion above the atmospheric boundary layer using quantitative imagery. *J. Appl. Meteor.*, reviewed by Jerry Crescenti.

Pikounis, M., E. Baltas, and M. Mimikou, 2001: Temporal sampling and bucket volume effects on tipping bucket measuring accuracy. *J. Atmos. Oceanic Technol.*, reviewed by Jerry Crescenti.

Wilson, K. B., D. B. Baldocchi, E. Falge, et al. 2001. The diurnal centroid of ecosystem energy and carbon fluxes at FLUXNET sites. *J. Geophys. Res.*, reviewed by Kirk Clawson

Travel

Tom Watson, October 10, to Charlottesville, Virginia, for the week long OAR Leadership Competencies Development Program. Tom also met with Bruce Hicks at the Air Resources Laboratory in Silver Spring.

Training

On October 18, 2001, Paula Fee completed the Online-Training Course "PassPort Training for Requesters". This 5 hour course is targeted to INEEL employees who request goods or services. The PassPort Software Solutions is an integrated work management tool developed by INDUS International, Inc. It is the software tool that was chosen to perform the Work Management and Supply Chain business functions at the INEEL. It will have a broad impact on work orders and material and contract requisitions. The new software will reduce the cycle time of ordering, receiving, and paying for materials. In the past, a BBWI procurement personnel entered all requisitions for supplies and services for FRD. Because of cutbacks in personnel, BBWI management requested that FRD and other non-BBWI offices begin entering the orders themselves in FY-2002.

Personnel

Debbie Lacroix and her husband, Lance, are the proud parents of a baby girl. Alexandria was born September 10 and weighed in at 8 lbs. 8½ oz. Both Debbie and Alexandria are doing well. Debbie will be on leave for a time before returning to work. Our congratulations to the family!